ANNUAL REPORT OF THE DIRECTOR

OF THE

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION

FOR THE YEAR ENDING JUNE 30th, 1911

AS REQUIRED BY ACT OF CONGRESS, AUGUST 30th, 1890

ANNUAL REPORT OF THE DIRECTOR OF THE EXPERIMENT STATION

President Robert L. Slagle,
College

Dear Sir:—

I have the honor to make the following report of the South Dakota Agricultural Experiment Station for the fiscal year ending June 30th, 1911.

ORGANIZATION

About the middle of the fiscal year the Agronomist, Clifford Willis, the Assistant Chief in Agronomy, J. V. Bopp, and the Chief Assistant in Agronomy, W. L. Burlison, resigned to accept better paying positions. The details of experiments were carried out as planned at the beginning of the year by assistants.

With the additional two thousand dollars received from the Adams Fund, a new project in Agronomy was undertaken. The other projects were continued as outlined in former reports.

Experiments are conducted along seven different lines as follows: Agronomy, Animal Husbandry, Botany, Chemistry, Dairying, Horticulture and Veterinary.

The fund received from the federal government by the provisions of the Hatch and Adams Acts is the only support this Station received during the year. Work along this line could be widened, so as to include every phase of agricultural activity, but we are limited both in funds and equipment.

The United States Department of Agriculture cooperated with this Station during the year in growing grains, sugar beets, and with the sub-station at Highmore along agronomy lines.

To date the experiments at the state stations have been in agronomy lines exclusively. However it is hoped that the time is not far distant when other lines will be undertaken. These stations are located at Highmore, Eureka and Cottonwood.

At the beginning of the fiscal year the Hatch and Adams funds were apportioned to the different departments, which includes part of the salary of each employee, as follows:

HATCH FUND

Agronomy	$ 1600	00
Animal Husbandry	1805	00
Botany	2000	00
Chemistry	1330	00
Dairy Husbandry	980	00
Executive (including printing)	5170	00
Horticulture	1315	00
Veterinary	800	00
Total	15000	00

ADAMS FUND

Agronomy	3400	00
Chemistry	1700	00
Dairy Husbandry	3810	00
Horticulture	5100	00
Veterinary	990	00
Total	15000	00
Grand Total		$30000 00

For the past four years the Adams fund has increased $2,000 annually until now the Station is receiving the full $15,000, the total provided for by the Act. The projects are as follows:

In the department of Agronomy, a system of crop ro-

tation is considered in a broader way than a trial of various combinations, especially the effect of rotations of crops upon the maintenance of soil fertility. Also an investigation of the morphological characteristics of corn, wheat and oats.

The department of Chemistry has finished the first part, the investigation and determination of digestion coefficients of our grains and fodders with horses; and has made a beginning on the second part, the effect of an unbalanced ration on the digestive tract and general physiological condition of the animal, etc.

In the department of Dairying the project of determing the effect of alkali water on milk, milk products and the dairy cow, has partially been completed. Work will be undertaken the coming year on the last phase of the problem: the effect of alkali water on the dairy cow. This will be done in co-operation with the department of Veterinary Science.

In the department of Horticulture the project of crossing the hardy wild fruits of the Northwest with the improved varieties. Sufficient progress has been made with hybridizing the native sand-cherry and native plum with Japanese plums and Chinese apricots, so that more attention can be given to the apple. Commercial nursery men are now propagating largely these new stone fruits and one hybrid raspberry originated in this department. With the apple the main work planned is the orgination of a hardy winter apple and a study of the unit characters of the apple with a view to their recombination into forms new to Horticulture.

The department of Veterinary Science expects to complete soon an investigation of the histology, bacteriology, and treatment of lump jaw in cattle. This department will co-operate the coming year with the departments of Chemistry and Dairy Husbandry, and no new project will be undertaken.

Each project under the Adams Act must first be approved by the officials of the United States Department of

Agriculture. When the investigation is completed other projects will be undertaken, but not necessarily by the departments now using the fund.

For a detailed account of the progress of the projects, see report of the chief of each department hereto attached and made a part of this report.

PUBLICATIONS

During the fiscal year just closed, nine bulletins of thirty thousand copies each, and one circular, were printed.

The results published were obtained from experiments and investigations in soils, cereals, beef, mutton, beet seed, fruit, dairying and veterinary medicine, as indicated by the following titles:

Bulletin 123. Milk Powder Starters in Creameries.
Bulletin 124. Progress of Grain Investigations.
Bulletin 125. Fattening Steers of Different Ages.
Bulletin 126. Alkali Soils.
Bulletin 127. Breeding and Feeding Sheep.
Bulletin 128. Progress in Wheat Investigations.
Bulletin 129. Growing Pedigreed Sugar Beet Seed in South Dakota.
Bulletin 130. Some New Fruits Originated from the Native Sand Cherry and Plum.
Bulletin 131. Scabies in Cattle.
Circular No. 1. Injurious Weeds Common in South Dakota.

Synopsis of Contents:

Bulletin No. 123, *"Milk Starters in Creameries,"* by the Department of Dairy Husbandry gives the results of experiments, original with this department, with starters made from powdered milk. As the creamery industry has become centralized not only in cities, but in rural districts, where the hand separator is used almost exclusively, and the skim milk is consumed on the farm for feeding, it has become a source of difficulty to obtain a constant supply of milk for starter-making. The introduction of the pow-

dered milk starter, which can be kept in stock indefinitely, makes the plant independent of the local milk supply for this purpose and enables the operator to obtain uniform results at all seasons of the year.

The bulletin contains tables showing the comparative strength of milk powder starters and those made from natural milk; the comparative development of acidity and bacteria in mother starters prepared from milk powder and natural skim milk; the scoring of butter produced from cream ripened with milk powder and natural milk starters. The text includes a description of the process of milk powdering with cost of starter obtained from this source, directions for dissolving the powder; and the cost advantage and disadvantage is compared with starters obtained from commercial cultures. The publication is of interest to the general reader as well as the creamery operator.

Bulletin No. 124. *"Progress in Grain Investigation,"* by the Department of Agronomy contains the results of experiments conducted at the sub-stations of Highmore, Eureka, and Cottonwood for periods of eight, three, and two years, respectively, with common and Durum wheat, oats, barley, corn, millet, grain, sorghums, and flax.

In addition to seasonal data and yields of the different varieties treated, the bulletin contains a brief resume of experiments in grain investigation at the substations, climatological data, and valuable suggestions for successful cropping systems. While of value to our agricultural interests in the entire state, it is of special interest to the farmers in that portion of the sate located between the farmers in that portion of the state located between the James and Missouri River vaileys as well as to the homesteader and prospective settler in the western part of South Dakota and contiguous territory.

Bulletin No. 125, *"Fattening Steers of Different Ages,"* by the Department of Animal Husbandry, gives the results of a feeding experiment covering a period of two years, of 127 days each, with three lots of steers, six in each, for each year's feeding period. The steers for the first year's

experiment were home-bred and obtained at Sioux City; for the second year's experiment were range-bred and purchased in the Omaha market.

The rations fed consisted of prairie hay, shelled corn, and linseed meal. As the experiment was closed, the cattle were sold in the Chicago market at prices prevailing at time of sale. In addition to the rational data in connection with each lot, the bulletin contains numerous tables giving individual gains by periods, total and averages, and the loss sustained during shipment to market, on rations of sheaf oats and prairie hay. A summary interpreting the results indicated by the experiment prefaces the contents. These deductions, arranged as summary conclusions, are intended for the practical stockman and feeder, as well as for the popular reader.

This publication should have more than passing attention from every one interested in beef production and intensified farming in which all by-products must be given economic attention. With the passing of the free range, due to the westward march of the settler, the range finished steer, as a factor in the nation's beef supply, is on the decrease, and his place must be filled by the one finished in the feed lot.

Bulletin No. 126, *"Alkali Soil,"* by the Department of Agronomy gives results obtained from preliminary investigations prompted by numerous inquiries as to the distribution and management of alkali land. Fortunately, in the eastern half of the state, the alkali evil is reduced to small isolated patches, usually poorly drained, where the subsoil salts have been brought to the surface due to abundant precipitation and subsequent evaporation, leaving white or brownish deposits.

The text contains a map of the state giving locations from which samples were received for analysis, and replies to questions sent the co-operators or samplers. A table of analyses is also included.

Bulletin No. 127, *"Breeding and Feeding Sheep,"* by the Department of Animal Husbandry gives the results of

experiments conducted with six of the leading breeds of sheep, crossed with western ews, extending over a period of six years, to determine the adaptability of the grades to our conditions. The breeds used for breeding purposes were the Cotswold, Hampshire, Oxford, Southdown, Shropshire, and Rambouillet. A brief history is given as to the origin, characteristics and development of each breed.

In addition to the tabular matter pertaining to the get of each breed, there are tables giving yield of wool, dressed weight per head and totals for the six year period. The extracts from letters received from commission men, to whom the clip during the experimental years was sent, giving their comments on the yearly consignments, are prefaced by an article on wool, considering the factors which affect its quality from a feeding standpoint.

Press Bulletin No. 2, by the Department of Veterinary Science prescribing treatment for sheep affected with tape worm, is included.

Bulletin No. 128, *"Progress in Wheat Investigation,"* by the Department of Agronomy reports and suggests cultural methods and management for the leading money crop of the state. South Dakota is classed with the three leading northwestern states as a wheat producer.

When we consider the wasteful methods by which the meager average of 12-1 bushels of this staple cereal was produced during the last decade in this state, yet in its infancy as a producer of agricultural wealth, and contemplate the average yield from the wheat fields of the old world, more than double ours, where wheat has been raised for centuries, a publication of this kind is timely. If its cultural instructions were carefully studied and practiced, the wheat yield of the state would be greatly increased.

Varieties to sow, variety tests, description of varieties, suggestions on tillage, manuring, seeding, and seed selection, are some of the topics under consideration. This bulletin should be read by land owners, wheat farmers, and others interested in the northwestern states.

Bulletin No. 129, *"Growing Pedigreed Sugar Beet Seed*

in South Dakota," by the Department of Chemistry, is a report of progress in the co-operative sugar beet production experiments conducted by this department of the Station and the Bureau of Plant Industry of the federal Department of Agriculture. The results published in bulletins Number 106, 117, 121, indicates the adaptability of the soil in this locality to the production of beets with a high sugar percentage content.

It has been decided to consider another phase of the beet production problem, and determine whether or not beets rich in sugar are capable of transmitting this desirable quality to succeding strains. Bulletin No. 129 is the introductory chapter of this new feature of the sugar beet investigations at this station on the increased production of pedigreed sugar beet seed which is now imported in large quantities from Europe.

BulletinNo. 130, *"Some New Fruits Originated from the Western Sand Cherry and Plum in the Department of Horticulutre,"* is a continuation of the work published in Bulletin No. 87, "The Improvement of the Western Sand Cherry," and No. 108, "New Hybrid Fruits." It records another epoch in this department's campaign for the origination and propagation of new and hardy fruits adapted to the rigid climatic conditions of the northwest prairie states. In this great plant laboratory, every introduced variety is on probation for hardiness and quality. If it fails in either of these, it is destroyed.

The casual reader realizes little, as he peruses the pages of this bulletin, the altruistic spirit, the infinite care, attention to details, the patience necessary for collecting, arranging, and compiling the results, before the descriptions of these new varieties could appear in bulletin form for gratuitious distribution.

Bulletin No. 131, *"Scabies in Cattle,"* a co-operative dipping experiment by the Department of Veterinary Science and the Bureau of Animal Industry, United States Department of Agriculture. The problem of stamping out this disease in South Dakota has been a serious one.

Under semi-open or range conditions, such as we have west of the Missouri river, cattle intermingle to a greater or less extent in spite of attempts to establish a quarantine, so that the dipped cattle become newly infected. Just such factors have been largely instrumental in preventing the complete eradication of the disease in this state. However, it is gratifying to know that ownig to the work of the state Live Stock Sanitary Board in co-operation with the United States Department of Agriculture, the disease is being eradicated and in a short time the quarantine will be raised from the entire state of South Dakota.

Circular 1, "*Injurious Weeds Common in South Dakota,*" by the Department of Agronomy, was compiled in reply to the numerous inquiries from several sources for advice as to the best methods of destroying common weeds.

The weeds under consideration are Russian Thistle, Canada Thistle, Wild Oats, Quack Grass, Wild Buckwheat, and Pigeon Grass. A brief description of each weed, giving its origin, characteristics, occurrence and habit of growth, is followed by directions for its suppression.

The continually increasing demand for the publications of this Station from people representing different trades and professions, and of late from public school libraries, indicates that, not only do all classes of people begin to realize the important role, experiment Stations are playing in the dissemination of the "new thought" in agriculture, but that there is a new era dawning in our educational system.

The following is a list of daily, weekly, and monthly publications received in exchange for the Station bulletins. It will be noted these publications are from all parts of the world and could be used to great advantage by students in the agricultural courses. But on account of the limited space in the general library of the college these exchanges are filed away in an inaccessible place and are of little value to the Institution.

EXCHANGE LIST

Domestic Periodicals

Agricultural Epitomist, Spencer, Indiana.
American Farm World, Chicago, Illinois.
American Fertilizer, Philadelphia, Pennsylvania.
American Hay, Flour and Feed, New York City, N. Y.
American Hereford Journal, Kansas City, Missouri.
American Poultry Advocate, Syracuse, New York.
American Miller, Chicago, Illinois.
American Sugar Industry, Chicago, Illinois.
American Swine Herd, Chicago, Illinois.
Better Fruits, Hood River, Oregon.
Children's Friend, Sioux Falls, South Dakota.
Country Gentlemen, Philadelphia, Pennsylvania.
Commercial Fertilizer, Atlanta, Georgia.
Connecticut Farmer, Hartford, Connecticut.
Coleman's Rural World, St. Louis, Missouri.
Cotton Seed, Atlanta, Georgia.
Dairy Record, St. Paul, Minnesota.
Dakota Farmer, Aberdeen, South Dakota.
Deutsch-Americanische Farmer, Lincoln, Nebraska.
Drovers Journal Stockman, South Omaha, Nebraska.
Elgin Dairy Report, Elgin, Illinois.
Farm and Real Estate Journal, Traer, Iowa.
Farm and Stock, St. Joseph, Missouri.
Farm, Field and Fireside, Chicago, Illinois.
Farm Life, Chicago, Illinois.
Farm Progress, St. Louis, Missouri.
Farm Stock and Home, Minneapolis, Minnesota.
Farmer, St. Paul, Minnesota.
Farmer's and Drover's Journal, Union Stock Yards, Chicago, Illinois.
Farmer's Guide, Huntington, Indiana.
Farm World, Augusta, Maine.
Field and Farm, Denver, Colorado.
Flour and Feed, Milwaukee, Wisconsin.
Fruit Grower, St. Joseph, Missouri.

Garden Magazine, New York, New York.
Hoard's Dairyman, Ft. Atkinson, Wisconsin.
Gos-Podarz, Omaha, Nebraska.
Holstein-Friesian World, Ithaca, New York.
Hospodarsky Listy, Chicago, Illinois.
Indian School Journal, Chilocco, Oklahoma.
Jersey Bulletin, Indianapolis, Indiana.
Kimball's Dairy Farmer, Waterloo, Iowa.
Kansas Farmer, Topeka, Kansas.
Lebanon Independent, Lebanon, South Dakota.
Long Island Agronomist, Medford, Long Island.
Missouri Agricultural College Farmer, Columbia, Mo.
National Farmer, St. Louis, Missouri.
National Stockman and Farmer, Chicago, Illinois.
Northwestern Agriculturist, Minnneapolis, Minn.
Oklahoma Farm Journal, Oklahoma City, Oklahoma.
Orange Judd Northwest, Minneapolis, Minnesota.
Pacific Dairy Review, San Francisco, California.
Poultry Topics, Lincoln, Nebraska.
Practical Dairyman, New York City, New York.
Progressive Poultry Journal, Mitchell, South Dakota.
Progressive Farmer and Southern Farm Gazette, Raleigh, North Carolina.
Pure Products, New York City, New York.
Reliable Poultry Journal, Quincy, Illinois.
Republic, St. Louis, Mo.
Rural New Yorker, New York.
Sioux Valley News, Canton, South Dakota.
Spokesman Review, Spokane, Washington.
Successful Farming, Des Moines, Iowa.
Successful Poultry Journal, Chicago, Illinois.
Sugar Beet, Philadelphia, Pennsylvania.
Wallace's Farmer, Des Moines, Iowa.
Weekly Live Stock Report, Chicago, Illinois.

Foreign Periodicals

Agricultural Gazette, Sydney, New South Wales, Australia.

Agricultural Chemistry, Bangalore, Mysore, India.

Bureau of Science, Manila, Phillipines Islands.

Boletin da Agriculture, Kingston, Jamica.

Department of Agriculture, Melbourne, Victoria, Australia.

Die LandWirtschaftlichen Versuchs Stationen, Berlin

El Agricultor Mexicano, Jauarez, Chib., Mexico.

Estacion Experimental Para cana de Agucia, Lima, Peru.

El Cultivo Del Triog, Buenos Ayres, Argentine Republic.

Hokido Agricultural Experiment Station, Sapporoa, Japan.

Journal of the Department of Agriculture, Adelaide, Australia.

Las Orges Culliness, Milan, Italy.

Natal Agricultural Journal and Mining Record, Maritzburg, South Africa.

New Zealand Dairyman, Willington, New Zealand.

O Criador Pau Lista, Sao Paulo, Brazil.

ANIMAL HUSBANDRY DEPARTMENT

Part of the work of this year was a continuation of that outlined in former reports, viz: (1) Breeding Western-bred ewes to pure bred rams and feeding progeny on the same kind of a grain ration. (2) Feeding steers of different ages on the same kind of grain ration to determine the relation of age to gain. (3) Development of a new breed of swine by crossing and selection to fix desirable characters. The swine experiment was closed on account of a disease in the herd. The results of (1) and (2) were printed and distributed.

In addition, an experiment in pig feeding with buttermilk, sweet skim milk and sour skim milk and pigs following cattle on a full feed of corn, and also an experiment

in feeding steers on silage, were undertaken, and will be continued.

I enclose herein and make a part of this report, reports from the various departments that give a more detailed statement of work in each department.

Respectfully submitted,
JAMES W. WILSON,
Director and Animal Husbandman.

FINANCIAL STATEMENT

James W. Wilson, Director, Experiment Station.

Dear Sir:—

I have the honor to transmit herewith schedules showing the receipts and expenditures on account of the Experiment Station, Sub-Stations, and Hog Cholera Serum work for the fiscal year ended June 30th, 1911.

Respectfully Submitted,
R. A. LARSON, Secretary.

EXPERIMENT STATIONS AND SUB-STATIONS

Receipts, 1910-1911

	Home Station	Highmore Sub-Station	Eureka Sub-Station	Cottonwood Sub-Station	Miscellaneous	Total
Hatch	15000 00					15000 00
Adams	15000 00					15000 00
State Appropriation		3000 00	2000 00	2000 00	2985 28	9985 28
Land Endowment					1409 32	1409 32
Sales of Produce, 1910	6102 47	64 07	134 80	80 57		6381 91
Balance on Hand	919 88				401 13	1321 01
	$37022 35	$3064 07	$2134 80	$2080 57	$4795 73	$49097 52

DISBURSEMENTS. 1910-1911

	Hatch	Adams	Home Station Local	Highmore Sub-Station	Eureka Sub-Station	Cotonwood Sub-Station	Total
Salary	7104 20	5871 55	.....	819 54	680 67	455 61	14931 57
Labor	2092 26	4170 81	824 23	844 75	448 43	489 25	8869 73
Publications	2331 54	.....	.....	500 00	40 87	40 80	2913 21
Postage and Stationery	109 63	108 75	48 10	31 69	31 44	31 44	361 05
Freight and Express	209 36	749 06	119 81	23 28	10 50	12 13	1124 14
Heat, Water and Light	7 20	94 32	60	5 20	3 80	.....	111 12
Chemical Supplies	483 23	883 02	.....	.....	.....	.....	1366 25
Seeds, etc.	299 05	1019 03	330 00	102 64	114 44	87 57	1952 73
Fertilizer	.....	50 10	.....	21 60	.....	.....	71 70
Feed	808 59	441 20	379 44	18 10	42 86	37 90	1728 09
Library	168 79	28 00	.....	.....	.....	.....	196 79
Tools Imp.	106 81	233 80	.....	.....	145 45	376 70	862 76
Furniture and Fixtures	418 72	145 15	50 35	342 40	54 00	54 00	1064 62
Scientific	588 59	203 33	65 00	64 00	.....	.....	920 92
Live Stock	.....	600 00	966 61	100 00	400 00	340 00	2406 61
Traveling Expenses	167 34	106 53	121 54	287 54	203 97	224 23	1111 15
Contingent	25 00	.....	.....	48 70	.....	.....	73 70
Buildings and Land	79 69	295 35	7 80	56 45	1085 50	1068 40	2593 19
	$15000 00	$15000 00	$2913 48	$3265 89	$3261 93	$3218 03	$42659 33
Balance on Hand Local Fund Home Station							4108 87
Balance on Hand Sub-Station Land							1303 04
Balance on Hand Buildings, Sub-Station							1026 28
							$49097 52

HOG CHOLERA SERUM FUND

RECEIPTS

July 1, 1910, Balance on hand	$1993 76

DISBURSEMENTS

Labor	847 00
Paid for pigs	826 75
Express and drayage	4 65
Gasoline	37 29
Straw	20 75
Feed	151 97
Instruments, etc	59 55
Labels, etc.	3 90
Hardware supplies	11 90
Miscellaneous	5 45
Lumber	10 01
Drugs, etc.	11 40
July 1st, 1911, Balance unexpended	3 14
	$1993 76

AGRONOMY DEPARTMENT

June 26, 1911.

Director James W. Wilson,
South Dakota Experiment Station,
Brookings, South Dakota.

Dear Sir:—

According to your request of recent date, I beg leave to make the following annual report for the Agronomy Department of this Experiment Station.

Since the previous Annual Report, the personnel of the Department has been completely reorganized. In fact, the new organization has been completed only within the present two weeks. It is thus obvious that I am making report of work, which has been, until recently, in charge of my predecessor.

Under the Adams project, the experimental work has been conducted in accordance with agreements made between this dpartment and the office of the Experiment Stations of the Department of Agriculture, Washington,

D. C. My understanding is that work carried on under the Adams project at this Experiment Station falls under two general divisions. First, a study of several crop rotations with the special object in mind of determining the comparative effect of these several rotations and the application of plant food made in connection with them in depleting, or maintaining, or increasing the fertility of the land. The rotations under this project consist of:

1. Corn, wheat, oats, clover.
2. Corn, oats, wheat, clover.
3. Corn, oats, clover.
4. Corn, wheat, legume.
5. Corn, barley, legume.
6. Corn Durum wheat, legume.
7. Continuous corn.
8. Continuous wheat.
9. Continuous barley.
10. Continuous oats.
11. Continuous Durum wheat.

The effect of these rotations upon soil is also being studied according to a definite plan. Chemical analyses are made of samples of soil taken from the center of each plot, by measurement, for nitrogen, phosphorus, potassium, calcium, magnesium, iron, aluminum, sodium, and insoluble matter. Such analyses will show the supply of the several plant food elements present in the soil at stated times, and by comparing these amounts, it will be possible to secure much desired information concerning the effects of the several cropping system. Furthermore, on certain plots definite plant food materials are supplied and their effects upon crop yields compared with each other and with check strips, with a view to securing by this means information concerning soil requirements. Further work, conducted under the Adams fund, consists of an investigation of the morphological characteristics of corn, wheat, oats. This part of the project has been continued only

within the present season. The following brief outline of the work is on file, having been arranged by Mr. W. L. Burlison:

1. Morphological characters in relation to desirable and undesirable qualities.

A. Structure of the plant.

I. The Nature of the leaf and its development.

II. Rooting habits of the plants.

III. Rapidity of plant growth.

IV. General form and size of plant.

V. A Morphological study of the corn ear and the wheat and oat head.

2. A Morphological study of larger groups.

I. Local Strains.

II. Introduced strains.

III. Improved strains.

IV. Morphological changes brought about by improvement.

3. Chemical studies.

1. It may be necessary to make a chemical investigation from the beginning in order to trace certain relationships which may appear during the progress of work.

Under the Hatch fund the work of determining which crops and which cropping systems may be the most suitable for permanent and profitable agriculture in South Dakota, is being continued. Such work has been under way for some years. One of the features more recently added to this project is the study of two systems of farming. First grain farming; and second, live stock farming. It is obvious that under a system of grain farming one must seek, as far as possible, to maintain a fertility and condition of the soil by proper crop rotation, by the turning under crop of residue and green manures, and, so far as may be necessary by the application of commercial plant food. Under a system of grain farming much plant food must necessarily be removed from the soil in the form of grain, which is sold.

Second, a live stock system differs from a grain system essentially in the fact that in such a system grain is

mainly fed to live stock on the farm rather than being sold away from the land, thus the actual plant food elements are taken away from the soil more slowly, but perhaps none the less surely, under a live stock system of farming. Morever, with live stock systems it is possible to have access to supplies of farm manure. It is through these supplies that plant food is taken from the soil and fed to stock, is again in part returned to the soil and furthermore, this same use of farm manure may largely assist in maintaining a supply of humus and thus indirectly a good physical condition and an adequate supply of water. A comparative study of live stock with grain systems of farming in South Dakota is of fundamental importance to the agriculture interests.

The relative cost of conducting the two systems and the relative profits which may be derived, therefrom, the possibilities of each of the two systems for soil maintenance, the economic effect of pursuing either of the two systems—all these are considerations which make such a study of vital interest under the conditions of South Dakota.

During the past year a number of bulletins have been issued by this Department. They are as follows:

Bulletin 124, *"Progress of Grain Investigations,"* by Clifford Willis and Manley Champlin. This bulletin is a report of work conducted at the Highmore, Eureka and Cottonwood Sub-Stations in co-operation with the United States Department of Agriculture.

Relative to wheat, the bulletin may be quoted as follows: "In general it may be said that the Bearded Fife types of common wheat are well adapted to this state and ripen earlier than the Blue Stem, producing a wheat of higher weight per bushel and better quality. Their worst fault in the field is shattering."

Oats. "In view of the changing seasons, it is recommended that South Dakota farmers grow both an early and late variety, and the varieties recommended are Sixty Day or Kherson Swedish Select. If care is taken to avoid mix-

ing, this practice will be found advantageous. The early variety will often be saved before an injurious storm occurs, while the late variety will make maximum yields when not interferred with by adverse weather conditions."

Barley. "The best six rowed barley is believed to be Minnesota No. 105. Among the two rowed Barleys, Hannah No. 24 has given good results and a new variety obtained from Svalof, Sweden, namely, Mannchen, No. 531, is also very favorably mentioned."

Millet. "Millets of the Fox-tail or Forage type and also of the Proso or grain type were tested. Millets of both classes have their chief value as catch crops to be sown where something else has failed."

Corn. "Results indicate that among varieties tested, Minnesota, No. 13 is the best Dent variety and North Dakota White seems to be the best Flint Variety."

Grain Sorghum. "Tests of grain sorghums substantiated the fact that as a class they are especially drought-resistant and are likely to prove very valuable under comparatively dry conditions."

Bulletin No. 126, Alkali Soils, by Clifford Willis, Chief in Agronomy and J. V. Bopp, Assistant Chief in Agronomy. This Bulletin makes report upon a preliminary survey of alkali soils in the state and deals with methods for alleviating the ill effects of the alkali materials in such soils. It is found that alkali spots are usually caused by evaporation of water from the surface soil and consequent deposition of salts held in solution. Thus it is concluded in this bulletin that surface mulches, whether of some kind of litter, or of natural earth, will act favorably in preventing this deposition of alkali. Thus deep prepartion and thorough surface cultivation are urged as methods for improving alkali soils. Applications of gypsum were not thought to be of special benefit in improving alkali spots. The most hopeful remedy for alkali soils consists of tile drainage. Such statement is based upon the theory and experience that salts in alkali spots are highly soluble and will be carried into the subsoil and into drain

tiles when the latter are put in. Thus tile drainage is a permanent remedy for the presence of excess of alkali in the surface soils.

In addition to the bulletins mentioned, I am informed that one is at present in press, dealing with the subject of "Wheat."

During the past year Circular No. 1 was issued from the Agronomy Department entitled "Injurious Weeds Common in South Dakota."

During the year a number of newspaper bulletins were also published. Among the subjects treated were, first, "Crops to Grow for Forage After Continued Drought"; second, "When and How Shall I Plow"; third, "The Irish Potato." Such Newspaper Bulletins offered timely and valuable advice to practical farming interests of the State.

From that which has been stated, it is evident that during the past year, under the direction of my predecessors, much has been accomplished of great value to the State. In the future, it will be the policy of this Department to continue and inaugurate lines of work which will be of practical and scientific importance to the crop producing interests. This Department has in mind that results are desired which may be practically applied It also has in mind that no results are practical except as they are based upon scientific data, "Science is knowledge, no more or less."

Very respectfully,
A. N. HUME, Agronomist.

BOTANICAL DEPARTMENT

Director James W. Wilson,
Agricultural Experiment Station,
Brookings, S. D.

Dear Sir:—

I beg leave to submit the following report on my experiment station work for the past year of 1910-1911. The

major part of my investigations concerned the life histories and general cytology of the Rusts. Some progress has been made, particularly in our knowledge of the sexual states. Further, some observations were made as to the possibility of grain rust being an internal parasite, thus being propagated by means of the seed.

Some cultural studies have been made on dry rot of potatoes which was prevalent last season in the western part of the state. We have continued as heretofore some special methods of eradication of quack grass and Canada thistle, both of which we find to be extremely common in the eastern half of the state.

E. W. OLIVE, Botanist.

CHEMICAL DEPARTMENT

Jas. W. Wilson, Director,
Dear Sir:—

The lines of work pursued by this Department during the past year are the same as those of the preceding one. Sugar Beet Investigations and digestion work with horses have been the major topics considered.

HATCH PROJECT

Under this caption falls the Sugar Beet investigations. I have to report very satisfactory work along these lines. We probably grew the best lot of mother beets in the United States during the current year. The number of varieties experimented with is smaller than in the previous year owing to selective processes. But the actual number of mother beets grown and analyzed is larger than at any previous time. About 4000 analyses have been made, with involves a large amount of work in proportion to the force employed in this Department. Last spring the scope of work was materially enlarged. More problems were taken

up, such as growing "Stechlinge," siloing in the field, commercial seed production, and spacing to secure maximum results. This is co-operative work with the Bureau of Plant Industry, U. S. Department of Agriculture, and a new line of inquiry in regard to the morphological structure of the Sugar Beet as related to its sugar content has been inaugurated.

Mr. F. J. Pritchard of the Bureau of Plant Industry has this work in immediate charge.

During the year a Bulletin No. 129 covering the investigations has been published. This Bulletin also gives full details of the work in progress.

ADAMS PROJECT.

As in previous years this work has to do with digestion studies on our native grains and forage crops. This work naturally divides itself into two divisions. First, the determination of the natural digestive coefficients under normal conditions. Second, the digestive results obtained under some of the unscientific practices pursued in this state which is liable to occur not only under range conditions but also under the conditons prevailing from time to time in the more favored sections.

The first part of this work is completed and the results will be given in a Bulletin to be issued during the early months of the next fiscal year. Also a small beginning on the second phase of the problem has been made. It is to be regretted that a shortage of competent assistants during the first part of the year has made the work on the second phase of the work smaller than was previously anticipated.

It is to be hoped that henceforth quick and substantial results will be obtained. In this second phase of the work the co-operation of the Department of Veterinary Medicine will be enlisted so that not only will the chemical features of these practices be investigated but also the deeper and more elusive physiological changes that accompany malnutrition.

This second part of this investigation is breaking into new ground and the results are not to be anticipated.

Respectfully submitted,
Jas. H. Shepherd, Chemist.

DAIRY HUSBANDRY DEPARTMENT

Director James Wilson, College.

Dear Sir:—

In compliance with your request I beg to submit a summary of last year's station work in this department.

A portion of the Adams Fund project, the effect of alkali water on dairy cows and dairy products, has been completed. The latter portion of this subject will be worked out during the coming year in co-operation with the Veterinary department.

This work with alkali water was begun in order to secure information with which to answer requests constantly coming in to this department. Alkali water is prevalent in many parts of this state, generally speaking all over the semi-arid west. Questions like the following are frequently asked: "Does alkali water cause cows to be 'alkalied'?" Does it injure the cows in any way? Does alkali water injure the milk for drinking purposes? Does it effect the milk for cheese making? Does it injure butter to be washed in alkali water? This latter question was asked by a practical creamery man at the National Creamerymen's Convention held at St. Paul three years ago. Not one in that large gathering from all over the United States was able to answer it.

The water used in these experiments has been shipped to this station from a well west of the Missouri river. Efforts were made to ship it by freight, but this was not found satisfactory. The water arrived irregularly. The long time in route caused it to freeze in cold weather. On account of these difficulties the water has been shipped

by express. Though expensive it is apparently impossible to obtain it in any other dependable way.

The well from which this alkali water has been shipped was chosen after the water from fifteen different wells, located in different sections, had been analyzed. This well was selected, first, because it was able to furnish a large constant supply of water; secondly, because it contained the most minerals of any water analyzed (it containing 3,000 parts of mineral per million parts water); thirdly, because it was located near the direct railroad to Brookings; fourthly, because people were afraid to use it for their stock.

The data relative to the effect of alkali water on dairy products is now being compiled. The manuscript containing detailed reports of the work will be sent to you for publication in the near future.

The Hatch fund allotment for this Department has been rather limited. So many subjects needing investigation are constantly arising that it would seem expedient if possible to set aside an additional sum.

During the last year a bulletin has been issued by this department on the "Use of Milk Powder Starters in Creameries." The use of hand separators on the farm, and the centralization of creameries have made it difficult to secure natural skim milk at the creameries at a reasonable cost.

The results of our experiments show that skim milk made from Milk Powder is a suitable medium for the desirable or lactic acid producing bacteria, and that Milk Powder in every other way, by proper treatment such as outlined in the bulletin, makes a suitable substance to be used for starters in creameries.

The experiment on keeping ice on the farm and determining the per cent of ice by storing in different ways is still in progress. This work has been carried on for two years. It is the intention of the writer to get one year more data before publishing same.

Last year a new make of milking machine was in-

stalled in the dairy barn. Experiments on the comparative efficiency and the practicability of machine milking vs. hand milking are now in progress. On account of the various inquiries and the interest displayed in this subject, the writer would recommend that a preliminary report be published at the close of the first year's work.

In addition, the records of feed consumed and the products produced by each member of the dairy herd are kept. These records will in time make valuable data.

Respectfully submitted,

C. Larsen,

Professor of Dairy Husbandry.

HORTICULTURAL DEPARTMENT

Director James W. Wilson,

South Dakota Experiment Station,

Dear Sir:—

The work of the Department of Horticulture during the past year has been carried along the same lines outlined in previous reports. The work in fruit-breeding is necessarily planned to cover a long period of years, since it is a step-by-step process rather than a single stride. Experiments that were started when I first took charge of this work sixteen years ago are showing their best results now. Special attention has been devoted to the breeding of hardy orchard and small fruits, since most of the old list is deficient in hardiness or some other essential character.

THE HATCH FUND

The varieties in the Station orchards, both top worked and on their own stems, have been studied for some years with a view to publishing a bulletin on their relative value for cultivation. The same is true of the large collection of ornamental trees, shrubs, and perennials. Partial reports have been published but it is now time to publish the ex-

perience up to date. In apples, it is certainly true that we have a large variety of summer and fall apples which are sufficiently hardy for this climate, but the hardy winter apple has not yet appeared. As Secretary of the South Dakota State Horticultural Society the endeavor has been made to get the experience from all parts of the state but no appropriation has been available for the extended orchard survey which would be desirable.

It is highly desirable that the experiments in various parts of Horticulture should be made at all the sub-stations owing to the widely different climatic conditions. The need for this is self-evident since successful horticulture is an essential to home-making on the prairie.

The experiments in breeding hardy ever-blooming roses in this department has already resulted in some promising varieties, but before introducing any of them it may be better to continue the work and develop something of greater merit. During the past year several thousand blossoms were crossed with some of the best roses under cultivation. I am working mainly with the Siberian Rosa rugosa and our native wild roses.

INTRODUCING HARDY ALFALFAS.

The work begun last year of sending out one year old alfalfa plants, which I secured as Agricultural Explorer in Russia and Siberia for the United States Department of Agriculture, was continued last spring. I offered to send ten plants free to the first ten applicants from each county and received about 800 letters, many counties exceeding their quota. The work of distribution was confined chiefly to the following four varieties: Omsk 1908 Siberia, Semipalatinsk Siberia, Cherno and Cossack. In addition, many plants were sent by express to other planters and experiment stations in other states. This preliminary work of distributing does not interfere in any way with the alfalfa feeding tests by the Department of Animal Husbandry, nor with the experiments by the Agronomy department with Alfalfa as a field crop and in rotations.

The plan in this work of distribution is to have the plants set some distance apart, thus permitting them to seed heavily. For example: a single one year plant set in 1909 bore 16,000 seeds in 1910. The present season one plant set in 1906 is bearing fully 25,000 seeds. A few hundred acres set out in this manner would soon make it possible for each farmer to get a bushel of seed and this would quickly solve the alfalfa question. My personal belief is that these Siberian and Eastern varieties will make alfalfa culture profitable on the American continent clear up to the Arctic Circle. To compute accurately the money value of such alfalfas would be impossible. The legislature last March appropriated $1,000 annually for two years to test these new alfalfas in every county in the state. The great and urgent need of South Dakota agriculture is an alfalfa that will not winter-kill more or less under any conditions. Not one of the old alfalfas will meet this demand, hence this new work is worth while.

The underlying philosophy which I have formulated during this work is that nature can make a plant hardy but man cannot; or, technically speaking, acclimation is possible, but acclimatization is impossible. This philosophy is apparent not only with alfalfa, but with fruits, trees, shrubs and ornamentals.

THE ADAMS FUND

The work with plums and sand cherries has resulted in numerous hybrids which are now being propagated on a large scale by the commercial nurserymen. Some of the results are described in Bulletin 130, June, 1911, "Some New Fruits Originated from the Native Sand Cherry and Plum." The most striking results have been obtained by hybridizing the native plum with the Chinese apricot and the native sand cherry with the Japanese plum. The present season these new hybrids fruits are bearing a heavy crop and many new seedlings are coming into bearing for the first time.

Out of the many thousands of seedling raspberries

raised here only one has been named and introduced so far, the Sunbeam, which is now on the recommended Fruit Lists of the Minnesota and South Dakota State Horticultural Societies, since it has proven its decided value over a wide area. It is hardy without the winter covering, the necessity for which heretofore has hindered the successful culture of raspberries by the South Dakota farmer.

During the winter the work of breeding strawberries was carried on in the greenhouse and much seed was obtained. The new Fruit-Breeding greenhouse erected under the appropriation by the legislature two years ago has proved a great help in this work. Hundreds of fruit trees are grown on dwarf stocks in tubs, thus permitting the work of crossing to be done under the glass, so that the more glass area we have the more of this work can be done. Over winter these plants are stored in two specially constructed cellars. I am pleased to note that this method is now being followed by other stations.

Good progress has been made in the breeding of hardy apples and I trust that soon we can have an apple that will keep through the winter and until apples come again, and still be of perfect hardiness in tree. A new bulletin is planned presenting some of the genetic principles deduced from these experiments.

Respectfully submitted,
N. E. Hansen, Horticultrist.

VETERINARY DEPARTMENT

Prof. J. W. Wilson, College

Dear Sir:—

I have the honor to report that the work in this Department during the past fiscal year has been concerned, first, with the continuation of the work on lumpy jaw. A distinct advance has been made in this work in that we have been able to demonstrate a filamentous structure in Gram negative pus from these lesions. Our cultural ex-

periments in connection with this pus have not been followed with satisfactory results and I believe further continuation of this phase of the work is necessary. Experimental injections into rabbits have proved negative.

Second, our results of relationship caused between potent hog cholera serum and its power to produce agglutiation of culture of B. cholera suis, virulent for rabbits, have proved negative, that is we have found hog cholera serum may be Potent and may or may not possess glutinating reactions treating the cholera suis.

Third, in addition to this we have been engaged in the manufacture of hog cholera serum, through funds provided two years ago by the State Legislature for this purpose. Reports from the use of this serum have been highly satisfactory. We have saved ninety-two per cent of all hogs that have been injected.

It was at first that only a limited amount of serum could be manufactured during the present year. Owing, however, to an improvment in technique, we are in hopes that the money obtained through the sale of this serum during the past two years will be sufficient to carry us well into the winter.

Very Respectfully,

E. L. Moore.